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# **FINAL TECHNICAL REPORT**

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*In Support of the*

**Sixth International Conference on Materials and Mechanisms of  
Superconductivity and High Temperature Superconductors**

**University of Houston Project Number 1-5-51094**

**Dr. Paul C. W. Chu, Principal Investigator  
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## Report from the Organizers

The 6<sup>th</sup> International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors, M<sup>2</sup>S-HTSC-VI, was held in Houston, Texas, from February 20 to 25, 2000. The previous five M<sup>2</sup>S-HTSC conferences took place in Interlaken, Switzerland (1988); Stanford, USA (1989); Kanazawa, Japan (1991); Grenoble, France (1994); and Beijing, China (1997). The M<sup>2</sup>S-HTSC conference series can be traced back to the "d- and f-band" superconductivity conferences initiated by David Douglass at Rochester, New York in 1971. The subsequent conferences were held at Gatlinburg, Tennessee (1973); Rochester, New York (1976); La Jolla, California (1979); Karlsruhe, Germany (1982); and Ames, Iowa (1984), all of which one of us (CWC) had the fortune to attend. The scope of these conferences has expanded continuously, both in topics and participants, from the d- and f-band superconductors by participants mostly from the U.S. initially, to include organic and oxide superconductors with many researchers also from Japan and Europe in and after the La Jolla conference. With the advent of the cuprate superconductors, high temperature superconductors have taken the center stage of the Interlaken and later M<sup>2</sup>S-HTSC conferences, as is also reflected in the title of these conferences.

The Texas Center for Superconductivity at the University of Houston took great pride in hosting the M<sup>2</sup>S-HTSC-VI, the first such conference in our field for the new millennium. It was particularly pleasing to us when, prior to the conference, we were told by the White House that the first liquid nitrogen superconductor, YBCO, was to be enclosed in the 20<sup>th</sup> century time capsule together with other great inventions of this century. We are all looking forward to the day 100 years from now when the time capsule is opened, and our grand children and great-grandchildren will understand high temperature superconductivity as we do the hydrogen atom today and will live in a more environmentally friendly world with more comforts, as promised by high temperature superconductivity technology.

Great progress has been made in all areas of superconductivity, especially in high temperature superconductivity, since our last M<sup>2</sup>S-HTSC conference in Beijing. The long sustaining interest in high temperature superconductivity by the general public over the last decade stems, to a large extent, from its technological promises. The synergism between scientific study and technology development has never been more obvious than in the recent investigation of high temperature superconductors. After extensive discussions in the Program Committee and with some members of the International Advisory Committee, the scope of M<sup>2</sup>S-HTSC-VI was broadened to include the applied (processing and applications) aspects of superconductivity research, which accounted for about 18% of the papers delivered at the conference. Such a change has been viewed to be a positive one by the majority of the conference attendees. M<sup>2</sup>S-HTSC-VI therefore addressed four general areas of superconductivity research: theories, experiments, materials, and applications.

M<sup>2</sup>S-HTSC-VI followed more-or-less the organizational format adopted by M<sup>2</sup>S-HTSC-V at Beijing. It included plenary talks, invited and contributed oral and poster presentations, hot topic sessions, and conference summary presentations. The invited oral presentations were grouped into two categories: micro-symposia and regular sessions, with the former dealing with the topics of current interest more systematic and in-depth than the latter. To encourage informal and frank

exchange among theorists, so researchers, both theoretical and experimental, can recognize the crucial scientific issues that remain, we organized a "Point-Counterpoint" Brown Bag Session, chaired by Marvin Cohen (*aka* Larry King), and John Ruvalds, with Phil Anderson, Bob Laughlin and Maurice Rice as discussion leaders. The differences and similarities between various models were therefore brought out more clearly and better contrasted. It may be a good idea in future M<sup>2</sup>S-HTSC conferences to hold similar sessions among experimentalists to identify possible disagreements between the data from different experiments, and among theorists and experimentalists to assess the limitations of and inconsistencies between experimental data reported and theoretical models proposed.

It was most fitting for M<sup>2</sup>S-HTSC-VI to celebrate the 80<sup>th</sup> birthday of Professor Ted Geballe. Ted has been a major contributor to the discovery and development of superconducting materials and a continuous inspiration to many, including one of us (CWC), who have dedicated their lives to the discovery of novel materials and physical phenomena. A special "Symposium in Honor of T. H. Geballe: The Search for New Materials" was therefore organized and chaired by Mac Beasley and Paul Chu. The impact of Ted's work on various superconducting material systems were briefly reviewed by Phil Anderson, John Rowell, Frank DiSalvo, Oystein Fischer, Rick Greene and Zack Fisk. Ted concluded the Symposium by suggesting ways to conduct future searches for new materials.

The outreach efforts to the community, including high school students, were another addition to the M<sup>2</sup>S-HTSC-VI conference. The phenomena of high temperature superconductivity have continued to arouse curiosity and amazement in the general public. A special session of public lectures by prominent researchers (Bob Schrieffer, Paul Chu, Kristian Fossheim, Paul Grant, Harold Weinstock, Don Gubser, and H. Fujimoto) were held to convey to the local high school students, teachers and members of the Houston community the sense of excitement in the study and development of fundamental and applied superconductivity. We believe that such efforts are important to attracting more youngsters to science (not necessarily only to superconductivity) and to winning more public support for science by enhancing public awareness.

For the first time, nominating committees and voting procedures were formally established for the HTS Prizes awarded during the M<sup>2</sup>S-HTSC-VI conference. In addition, each prize recipient gave a special lecture during the conference. Three 2000 Prizes were awarded as follows: The John Bardeen Prize for theoretical work that has provided significant insights on the nature of superconductivity and has led to verifiable predictions, was awarded to T. Maurice Rice. The Bernd T. Matthias Prize for innovative contributions to the material aspects of superconductivity, was awarded to M. Brian Maple. Beginning in 2000, the Matthias Prize is sponsored by the Texas Center for Superconductivity at the University of Houston. The new H. Kamerlingh Onnes Prize for outstanding experiments that illuminate the nature of superconductivity other than materials, was established by Elsevier Science, publisher of *Physica C-Superconductivity and its Applications*. The first H. Kamerlingh Onnes Prize was awarded to Zhi-Xun Shen.

The M<sup>2</sup>S-HTSC-VI conference was enhanced by the following exhibitors: CAN Superconductors (Czech Republic); Coating and Crystal Technology (Kittanning, PA); Elsevier Science (Amsterdam, The Netherlands); Epion Corporation (Billerica, MA); Intermagnetics General Corporation (Latham, NY); Neocera, Inc. (Beltsville, MD); Nichiden Machinery, Ltd.

(Kusatsu Siga Ken, Japan); Nove Technologies, Inc. (Darien, CT); Oxford Instruments America, Inc. (Concord, MA); and Princeton Scientific Corp. (Princeton, NJ).

There are many persons to thank for making M<sup>2</sup>S-HTSC-VI possible. The success of the conference is due in large part to the participants, especially those mentioned above, who served above the call of duty. The quality of the scientific program was due to the outstanding advice and guidance from the M<sup>2</sup>S-HTSC International Committee and especially from previous organizers, Z. X. Zhao (1997) and Benoy Chakraverty (1994); the Program Committee; and the Posters Committee, co-chaired by Jim Meen, Bernd Lorentz, Ann Heilman, and Jarek Wosik.

We are grateful to the capable staff of Centennial Conferences in Boulder, Colorado, for their excellent assistance in all things managerial, to Don Waterman and staff for their financial acumen, to members of the entire TCSUH Office for Public Affairs and the Local Committee headed and chaired, respectively by Sue Butler, our Conference Secretary, for the many sleepless nights and weekends, and to Rodney Perkins and Ron Hall for being sure we were 'connected' via the world wide web. The Special Events Committee, headed by Diane Schillaci, and staff at the City of Houston's Visitors and Convention Bureau, the George R. Brown Convention Center, the Hyatt Regency Downtown Houston, and the Houston Museum of Natural Sciences are to be commended for their efforts to make our city shine.

A conference of such magnitude would not have been possible without financial support from the Air Force Office of Scientific Research; Argonne National Laboratory; Danka; Department of Physics, University of Texas; Elsevier Science Publishers; Houston Cellular; Institute for Space System Operations, University of Houston; K. T. Li Foundation, Taiwan, Republic of China; Laboratory for Advanced Materials at Stanford University; Los Alamos National Laboratory; Materials Science Division, Argonne National Laboratory; NASA/Johnson Space Center; National Science Foundation; Science and Technology Center for Superconductivity, University of Illinois at Urbana-Champaign; Texas Center for Superconductivity, University of Houston; University of Houston College of Natural Sciences and Mathematics; University of Houston Division of Research; U. S. Department of Energy Superconductivity Program for Electric Power Systems; and the U. S. Department of the Navy, Office of Naval Research. For this, we would like to express our sincere thanks, especially to TCSUH for the generous assistance of personnel and finances.

Last, but not least, we thank the reviewers and members of the Publications Committee, whose hard work enabled the printing of the Proceedings.

Co-Chairmen, M<sup>2</sup>S-HTSC-VI:

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